Ural Federal University

named after the first President of Russia B.N.Yeltsin

DOCTORAL PROGRAMS

- PHYSICS AND ASTRONOMY
- BIOLOGY
- CHEMISTRY
- MATHEMATICS AND MECHANICS
- COMPUTER AND INFORMATION SCIENCES
- COMPUTER SCIENCE AND ENGINEERING

CONTENTS

INSTITUTE OF NATURAL SCIENCES

INSTITUTE OF MATHEMATICS AND COMPUTER SCIENCE

INSTITUTE OF FUNDAMENTAL EDUCATION

High-quality education has always been of value; today it remains an important asset all over the globe. The level of development of the country is directly dependent on the level of scientific cognition of the nature and the society, as well as on the broad use of scientific achievements in engineering and technology. Thus the need for specialists with experience in research will only grow in the years to come.

We invite all researchers interested in the mysteries of the Universe and the organic and inorganic nature, the development of technology, economic and social spheres of life, to pursue their doctoral studies at Ural Federal University. Being one of the leading Russian universities in terms of research activities, Ural Federal University possesses all necessary facilities for doctoral students to pursue their studies in such fields as Natural Sciences, Mathematics, Engineering, Human Sciences, and Economics. Scientific advisors working with doctoral students have broad experience of working in the leading universities of the world.

Vladimir Kruzhaev,
UrFU Vice-rector
for Research

ABOUT THE INSTITUTE

Ural Federal University
named after the first President of Russia B.N.Yeltsin
Institute of Natural Sciences

UrFU Institute of Natural Sciences is comprised of three faculties: Faculty of Biology, Faculty of Physics and Faculty of Chemistry. The key areas of research at the Institute include condensed state physics, physics of magnetic phenomena, molecular physics, stellar astronomy, biology, solid state chemistry, physical chemistry of macromolecules, organic synthesis, ecology. In addition, an important part of the Institute is the Research Institute for Physics and Applied Mathematics, which carries out scientific research in a large number of areas.

The Institute is also involved in environmental research and circumterrestrial space monitoring. The Kourovka Astronomical Observatory, the observatory located farthest to the East in Europe and being one of the most advanced in Russia, is part of the global space monitoring network. The Institute also has a unique biology station located between the rivers Iset and Sysert on the eastern slope of the Mid Urals, on the borderline of the southern taiga subzones and the pre-steppe zone.

The Institute's graduates make up the core of institutes of the Ural Branch of the Russian Academy of Sciences, research laboratories of industrial corporations, and science intensive businesses. Many of the Institute's graduates work successfully in the hi-tech industries, chemical testing and environmental laboratories, clinical diagnosis and medical genetics centers and laboratories.

INSTITUTE OF NATURAL SCIENCES

DOCTORAL STUDIES AT THE INS

UrFU Institute of Natural Sciences offers a wide range of Doctoral Programs in the fields of Physics and Astronomy, Biology and Chemistry. In this brochure you will find a brief description of the Faculties of the INS and its Doctoral Programs, along with the information about the Thesis Advisors.

We offer:

- 4 year Doctoral Programs.
- Accommodation in a University dorm.
- The possibility to be employed as a researcher in the group of your thesis advisor.
- Free Russian language courses.
- The possibility to defend the Candidate of Science* thesis or an UrFU PhD thesis.

*The first doctoral degree in Russia (Kandidat Nauk). It is gained after 3 to 5 years in a post-graduate school. The qualification requirements include mandatory publications in peer reviewed journals and approval on the Federal government level.

Entry requirements:

- Master's Degree in a field related to the field of Doctoral Studies.
- B2 level of English or Russian.
- Interview.

For further information, please contact:

Svetlana Zimnitskaia
s.a.zimnitskaia@urfu.ru

FACULTY OF BIOLOGY

Svetlana Zimnitskaia
Director of the Faculty

s.a.zimnitskaya@urfu.ru

About the Faculty

UrFU Faculty of Biology is one of the leading among Russian universities. One of the things that make the Faculty unique is the access that students and researchers have to the INS Botanical Garden and the INS Biological Station. Students of the Faculty study life in all its forms, physical and chemical mechanisms and global processes in the biosphere, and acquire the practical and analytical skills necessary to manipulate living systems.

Our students graduate with the necessary set of skills to conduct research, to develop scientific, industrial, design, management, organizational and pedagogical activities in organizations working on solving biological and environmental problems; in the biomedical industry and clinical diagnostic laboratories; in the field of biotechnology, phyto landscapes and interiors; in academic research organizations, museums, zoos, nature reserves, national parks.

Department	Head of Department
Department of Botany	Victor Mukhin victor.mukhin@ipae.uran.ru
Department of Zoology	Vladimir Vershinin vol_de_mar@list.ru
Department of Plant Physiology and Biochemistry	Irina Kiseleva Irina.Kiseleva@urfu.ru
Department of Ecology	Vladimir Bolshakov V.N.Bolshakov@urfu.ru
Department of Fundamental Medicine	Irina Danilova ig-danilova@yandex.ru
Department of Human and Animal Physiology	Boris Yushkov b.yushkov@iip.uran.ru

Botanical Garden

The INS Botanical Garden is the oldest in Ekaterinburg and is part of the Botanic Gardens Conservation International.

The Garden includes an arboretum which is designed as a landscaped park with the principle of geographical placement of plants. The garden features a collection of rare and endangered plants listed in the Red Book of Russia, the Urals and the Sverdlovsk region. The "Park of Rare Plants" is a landscape exhibition of the "Poaceae" and "Amaranth" families. A collection of subtropical and tropical plants is located in the greenhouses. The park's collection of cacti and succulents is one of the largest in Russia.

The Botanical Garden is among the largest in Russia in terms of the number of cultivated species in need of protection. In the Main Botanical Garden of the Russian Academy of Sciences (Moscow), there are 320 species; in the Botanical Garden of the Botanical Institute of the Russian Academy of Sciences (St. Petersburg) – 300 species; in the botanical garden of the Moscow State University – 166 species and in the botanical garden of the Ural Branch of the Russian Academy of Sciences (Ekaterinburg) – 130 species.

Biological Station

The INS Biological Station is located on the border of the southern taiga subzone and forest areas, in the junction of the rivers Iset and Sysert. The abundance of different types of ecosystems (forest, grassland, water, swamp, steppe slopes, agricultural and ruderal habitats, etc.) provides a unique opportunity to study the biodiversity of the area.

The Biological Station is a good base for training biology and ecology students. It is also the testing ground for the implementation of research projects conducted by undergraduate and graduate students and the staff of the Faculty of Biology. In addition, it is the perfect venue for voluntary environmental actions by INS students and staff.

Biodiversity is studied at all levels starting from the genetic level to the whole ecosystems. Research is conducted in order to assess the biological resources of the Ural region; to study symbiotic complexes in the biosphere cycle and homeostasis of Earth's ecosystems. Various projects involve not only INS scholars, but also colleagues from institutes of the Russian Academy of Sciences and foreign partners.

PHYSIOLOGY

Department of Human and Animal Physiology

The program is focused on training specialists in effective experimental methods for research activities associated with carrying out fundamental and applied research in the field of physiology of man and animals.

Dr. Boris Yushkov
Head of Department, Professor, Honored Scientist of the Russian Federation

b.yushkov@iip.uran.ru

The main research directions are:

1. Mechanisms of regulation of tissue regeneration under the action of the organism to extreme factors.
2. Immunological regulation of physiological functions.
3. Blood regulation mechanisms under the exposure of the human organism to extreme factors.

Research interests:

- The study of the regulation of hematopoiesis and development of the concept of immunological regulation of physiological functions in normal and pathological processes.

Main publications:

- *Antropova I. P.,Reino E. V., Yushkov B. G., Shlykov I. L. Varaksin A. N.* Blood coagulation at major orthopaedic surgery//J. Blood Disorders & Transfusion. 2013. V. 5, № 1. 4 p.
  DOI: 10.4172/2155-9864.1000178
- *Antropova I. P., Yushkov B. G., Shlykov I. L.* Effect of age on hemostatic function in patients with degenerative diseases of the large joints // International Journal of Biomedicine. 2013. V. 3, № 2. P. 90–93.
  HTTP://www.ijbm.org/articles/3_2_CR8.pdf
- *Krivopalov S. A., Yushkov B. G.* Sex differences in behavioral reaction of Krushinsky-Molodkina rat strain // Materials of 1st Congress Audiogenic Epilepsy "From Models to the Clinic". Salamanca, Spain, 2014. P. 32.
  HTTP://eventum.usal.es/event_detail/990/accepted_abstracts/audiogenic-epilepsy_-from-models-to-the-clinic.html

BIODIVERSITY AND ECOLOGY OF PLANT AND FUNGI IN A CHANGING WORLD

Department of Botany

The program focuses on training specialists in botany, mycology ecology of plants and fungi, familiar with classical methods of field researches as well as high-tech experimental methods.

Dr. Victor Mukhin
Professor

victor.mukhin@ipae.uran.ru

Research interests:

- Mycology.
- Botany.
- Ecology.
- Physiology of Fungi.
- Mycogeography.

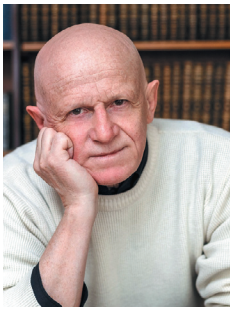
Main publications:

- *Mukhin V. A., Voronin P. Yu., Velivetskaya T. A., Ignat'ev A. V.* Stable Carbon Isotope Ration in Xylotrophic Fungi and Their Substrates // Russian Journal of Ecology. 2014. V. 45, № 1. P. 11–17. DOI: 10.1134/S1067413614010093
- *Mukhin V. A., Voronin P. Yu., Velivetskaya T. A., Ignat'ev A. V.* Stable Nitrogen Isotope Ration in Wood Substrates and Xylotrophic Fungi in Forest Ecosystems of Western Siberia // Russian Journal of Ecology. 2014. V. 45, № 6. P. 539–546. DOI: 10.1134/S1067413614060095

EVOLUTIONARY PATTERNS IN THE DENTITION OF RODENTS. SMALL MAMMALS AS INDIRECT BIOTIC MARKERS FOR CLIMATE DYNAMICS ASSESSMENT. FOSSIL RECORDS AND MOLECULAR PHYLOGEOGRAPHY OF ANIMALS

Department of Ecology

The program includes both theoretical and practical courses in evolutional morphology of vertebrata, evolutional ecology, biochronology and biostratigraphy of Quaternary. The students will have the opportunity to conduct research for their PhD thesis and participate in field research in different parts of the Urals and Siberia.



Dr. Aleksandr Borodin
Professor

bor@ipae.uran.ru

Research interests:

- Evolutionary ecology and morphological evolution of mammals.
- Quaternary biochronology and biostratigraphy.
- Phylogeography.
- Evolutionary studies based on both paleontological and neontological approaches.

Main publications:

- *Borodin A., Markova E., Zinovyev E., Strukova T., Fominykh M., Zykov S.* Quaternary rodent and insect faunas of the Urals and Western Siberia: connection between Europe and Asia // Quaternary International. 2014. V. 284. P. 132–150. DOI: 10.1016/j.quaint.2011.07.050
- *Strukova T. V., Bachura O. P., Borodin A. V., Stefanovskii V. V.* Mammal fauna first found in alluvial-speleogenic formations of the late Neopleistocene and Holocene, northern Urals, locality Cheremukhovo-1 // Stratigraphy and Geological Correlation. 2006. 14 (1). P. 91–101. DOI: 10.1134/S0869593806010060
- *Borodin A. V.* Opredelitel' zubov polevok Urala i Zapadnoy Sibiri (Pozdniy pleystotsen-sovremennost [A Diagnostic Guide to Teeth of Arvicolines of the Urals and Western Siberia (Late Pleistocene – modern time)]. Ural Branch of the Russian Academy of Sciences Publishing, Yekaterinburg, 2009. 100 p. (in Russian). HTTP://lib.ipae.uran.ru/key_arvicolinae/

Entry requirements:

- Good knowledge of zoology or Quaternary geology and molecular genetics.

PLANT PHYSIOLOGY AND BIOCHEMISTRY

Department of Plant Physiology and Biochemistry

The program includes both theoretical and practical courses in plant molecular physiology and biotechnology. The students will have the opportunity to conduct research for their PhD thesis and participate in laboratory and field studies, as well as field trips.

Dr. Irina Kiseleva (Kiselyova)
Head of Department

Irina.Kiseleva@urfu.ru

Research interests:

- Study of sink-source relations in plants, developmental (ontogenetic) and ecological aspects of photosynthesis, plant tolerance, molecular physiology of cereals.

Main publications:

- *Fazlieva E. R., Kiseleva I. S., Zhuikova T. V.* Antioxidant Activity in the Leaves of Melilotus albus and Trifolium medium from Man-Made Disturbed Habitats in the Middle Urals under the Influence of Copper // Russian Journal of Plant Physiology. 2012. V. 59, № 3. P. 333–338. DOI: 10.1134/S1021443712030065
- *Khramtsova E. V., Kiseleva I. S.* Genome-dependent factors in the development of leaf phototrophic tissues in diploid and alloploid wheat species // Russian Journal of Plant Physiology. 2004. V. 51, № 2. P. 278–286. DOI: 10.1023/B:RUPP.0000019222.76063.e1
- *Kiseleva I. S., Kaminskaya O. A.* Hormonal regulation of assimilate utilization in barley leaves // Russian Journal of Plant Physiology. 1998. V. 45, № 4. P. 549–556. DOI: 10.1023/A:1016324312244

Entry requirements:

- Basic knowledge of molecular plant physiology.
- Skills in molecular genetics and physiological and biochemical methods.

ECOLOGY OF AMPHIBIAN MORPHOGENESIS UNDER EFFECT OF NATURAL AND MAN-TRANSFORMED ENVIRONMENT

Department of Zoology

The main objective of the program is to develop a new methodology based on ecological functional analysis of morphological abnormalities' formation mechanisms in natural populations of amphibians under the influence of anthropogenic transformation of the environment. The general theoretical significance of this area can be briefly described as evolutionary teratology. This approach allows using the new parameters in the assessment of potential risks to human and animal populations under the effect of pollution and urbanization.

Dr. Vladimir Vershinin
Head of Department

vol_de_mar@list.ru

Research interests:

- Population ecology of amphibian, effects of urbanization and anthropogenous transformation of ecosystems, ecological physiology, problems of adaptation, morphogenesis, ontogenetic stability, problems of evolution in natural and man-transformed environment, human ecology.

Main publications:

- *Vershinin V. L., Vershinina S. D.* Physiological similarity of morphs due to homologous alleles in representatives of the Ranidae family // Uspekhi sovremennoi Biologii. 2013. V. 113, № 5. P. 516–523 (in Russian).
  HTTP://elibrary.ru/item.asp?id=20819522
- *Vershinin V. L., Vershinina S. D.* Comparative Analysis of Hemoglobin Content in Four Species of Anurans from the Ural Uplands // Doklady Biologicheskoy Nauki. 2013. V. 450, № 4. P. 155–157.
  DOI: 10.1134/S0012496613030137
- *Vershinin V. L., Neustroeva N. S.* The Role of Trematode Infestation in the Specifics of Skeleton Morphogenesis of Rana arvalis Nilsson, 1842 // Doklady Biologicheskoy Nauki. 2011. V. 440, № 1. P. 290–292.
  DOI: 10.1134/S0012496611050073

THE STUDY OF IMMUNOPHYSIOLOGICAL REGENERATION PROCESS. THE ROLE OF IMMUNE CELLS IN THE REGULATION OF THE REGENERATION

Department of Fundamental Medicine

The subjects covered in the program include the study of immunophysiological regeneration process, the role of immune cells in the regulation of the regeneration, the flow cytometry, immunohistochemistry, cell technologies, enzyme-linked immunosorbent assay, western blotting, confocal microscopy.

Dr. Irina Danilova
Head of Department of Fundamental Medicine, Head of Laboratory of Morphology and Biochemistry, Institute of Immunology and Physiology of the Ural Branch of the Russian Academy of Science

lg-danilova @yandex.ru

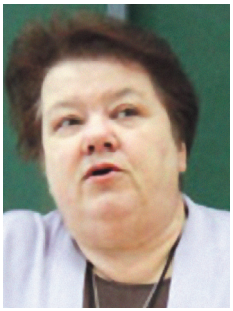
Research interests:

- The investigation of the mononuclear phagocyte system role in the regeneration of various tissues.

Main publications:

- *Danilova I. G., Sarapultsev P. A., Medvedeva S. U., Gette I. F., Bulavintceva T. S., Saraultsev A. P.* Morphological restructuring of myocardium during the early phase of experimental diabetes mellitus. Anat Rec (Hoboken). 2015. Feb; 298 (2). P. 396–407.
  DOI: 10.1002/ar.23052
- *Danilova I. G., Kazakova I. A., Yushkov B. G., Abidov M. T.* Modulation of macrphaes and response of CD117.
- *Sarapultsev A. P., Chupakhin O. N., Sarapultsev P. A., Rantsev M. A., Medvedeva S. U., Sidorova L. P., Abidov M. T., Danilova I. G.* Modulation of inflammatory response improves myocardial infarct healing in rats. Curr Pharm Des. 2014. № 20 (12). P. 1980–1986.
  DOI: 10.2174/13816128113199990492
- Modulation of macrophages and response of CD117 (+) cells of different localization after liver damage in mice. Bull Exp Biol Med. 2014. Jul; 157 (3). P. 357–359.
  DOI: 10.1007/s10517-014-2565-2

FACULTY OF PHYSICS



Natalia Zyryanova
Director of the Faculty

N.P.Zyryanova@urfu.ru

About the Faculty

UrFU Faculty of Physics is one of the leading faculties in Russia in this field. It has long-standing close ties with the institutes of the Russian Academy of Sciences, the largest industrial enterprises in the Urals and foreign research centers. Some of the faculty members are also members of the Russian Academy of Sciences and its branch academies.

The degrees offered at the Faculty are: "Physics", "Astronomy", "Radio Physics", "Geodesy and Remote Sensing", "Information systems and technologies (geographic information systems)", "Standardization and Metrology", "Nanotechnology and Microsystem Technology", "Innovation", "Hydrometeorology".

Department	Head of Department
Department of General Molecular Physics	Vladimir Chernyak vladimir.chernyak@urfu.ru
Department of Theoretical Physics	Alexander Moskvin alexander.moskvin@urfu.ru
Department of Low Temperature Physics	Alexey Babushkin Alexey.babushkin@urfu.ru
Department of Astronomy and Geodesy	Eduard Kuznetsov Eduard.Kuznetsov@urfu.ru
Department of Condensed Matter Physics	Nikolai Baranov n.v.baranov@urfu.ru
Department of Magnetism and Magnetic Nanomaterials	Vladimir Vas'kovskiy vladimir.vaskovskiy@urfu.ru
Department of Computational Physics	Alexander Germanenko alexander.germanenko@urfu.ru

Kourovka Astronomical Observatory:

The Kourovka Astronomical Observatory is the easternmost observatory in Europe. It is the only observatory in the range of longitudes from Kazan to Irkutsk. The staff has been actively involved in the implementation of national and international programs to monitor stellar clusters, the Sun, comets, planets and their satellites, stars and star-forming regions and finding planetary systems around other stars. They also perform terrestrial optical observations of X-ray sources in synchronization with space experiments.

The international astronomy community has recognized the important role of the Observatory. In honor of Professor K. A. Barkhatova the International Astronomical Union named the minor planet number 5781 Barkhatova, in honor of the director of the observatory P. E. Zakharova – the minor planet number 4780 was named Polina, in honor of Associate Professor N. B. Frolova – the minor planet number 6165 was named Frolova. In 1996, the minor planet number 4964 was named Kourovka. The Observatory is a major observational base for future astronomers.

RELATIONSHIP BETWEEN STRUCTURE AND DEFORMATION/FRACTURE OF ROCK MATERIALS

Departments of Condensed Matter Physics and General and Molecular Physics

This program focuses on the study of hierarchical structure and deformation/fracture behavior of some rock materials.

Dr. Peter Panfilov
Professor

Peter.panfilov@urfu.ru

Research interests:

- Mechanisms of deformation and fracture of materials, rocks and hard tissues.

Main publications:

- *Panfilov P.* On the inherent fracture mode of iridium at room temperature // J. Mater. Sci. 2005. 40 (22). P. 5983–5987.
  DOI: 10.1007/s10853-005-1296-1
- *Panfilov P., Yermakov A., Antonova O., Pilyugin V.* Plastic deformation of polycrystalline iridium at room temperature // Platinum Metals Rev. 2009. 53, (3). P. 138–146.
  DOI: 10.1595/147106709X463318
- *Zaytsev D., Panfilov P.* Deformation behavior of human enamel and dentin-enamel junction under compression // Materials Science and Engineering. 2014. V. 34. P. 15–21.
  DOI: 10.1016/j.msec.2013.10.009
- *Zaytsev D., Ivashov A., Panfilov P.* Anisotropy of the mechanical properties of human dentin under shear testing // Materials Letters. 2015. V. 138. P. 219–221.
  DOI: 10.1016/j.matlet.2014.09.140

AMORPHOUS AND NANOSTRUCTURED MAGNETIC MATERIALS

Department of Magnetism and Magnetic Nanomaterials

During this program you will study the relationship between the structural and phase states and the magnetic properties of soft magnetic alloys in the form of rapidly quenched ribbons and thin films.

Dr. Vasiliy Kataev
Professor

vakataev@urfu.ru

Research interests:

- Study of the relationship of structural and phase state with magnetic properties of soft magnetic alloys in the form of rapidly quenched ribbons and thin films.

Main publications:

- *Mikhalitsyna E., Kataev V., Geydt P., Lepalovsky V., Lähderanta E.* Influence of Annealing on the Surface Topography and Magnetic Properties of Thin Films of the Finemet-type Alloy // Solid State Phenomena. 2015. DOI: 10.4028/www.scientific.net/SSP.233-234.699

Entry requirements:

- Skills in the field of measurement and the use of equipment for the heat treatment.

PHYSICS AND TECHNOLOGIES OF NEW HARD MAGNETIC MATERIALS

Department of Magnetism and Magnetic Nanomaterials

During this program you will focus on the study of the interface of the exchange interaction in composite materials based on ferromagnetic hard magnetic and soft magnetic phase components and aniferromagnetic inclusions.

Dr. Nikolai Kudrevatykh
Head of the Department of Solid State Magnetism

Nikolai.Kudrevatykh@urfu.ru

Research interests:

- Physics and technologies of hard magnetic materials on the base of rare-earth alloys and intermetallic compounds.

Main publications:

- *Ismard O., Andreev A., Kuz"min M., Skoursky Y., Gorbunov D., Kudrevatykh N. et al.* High magnetic field study of the Tm_2Fe_{17} and $Tm_2Fe_{17}D_{3.2}$ compounds // Physical Review B. 2013. V. 88. P. 174406-1–10.
  DOI: 10.1103/PhysRevB.88.174406
- *Kudrevatykh N. V., Andreev S. V. et. al.* Magnetic and mechanical properties of flexable magnetic rubber based on caoutchouc binders and nanostructural Re-3d-metal- boron powder fillers // 21-st Symposium "Nanostructures: Physics and Technology". Saint Peters-burg, Russia, June 23–28, 2013. P. 326–327.
- *Chukalkin Y. G., Teplykh A. E., Kudrevatykh N. V., Choo K. N., Lee S., Andreev A. V., Pirogov A. N.* Amorphous-crystalline state transformation induced by annealing in R 2Fe14B (R = Nd, Er) compounds // Journal of Alloys and Compounds. 2014. V. 615. P. 75–78.
  DOI: 10.1016/j.jallcom.2014.06.105

FUNDAMENTAL AND APPLIED RESEARCH OF HETEROGENEOUS MAGNETIC FILMS

Department of Magnetism and Magnetic Nanomaterials

The program focuses on the development of new functional materials based on volume and layered nanostructuring of magnetic films. Prototyping magnetic sensors will also be part of the program's objectives.

Dr. Vladimir Vas'kovskiy
Head of Department,
Professor

vladimir.vaskovskiy@urfu.ru

Research interests:

- Fundamental and applied research of heterogeneous magnetic films.

Main publications:

- *Kulesh N. A., Balymov K. G., Vas'kovskiy V. O., Svalov A. V., Sorokin A. N.* Anomalies in hysteresis properties of Fe20Ni80/Tb-Co films with unidirectional anisotropy // Thin Solid Films. 2015. V. 577. P. 1–5. DOI: 10.1016/j.tsf.2015.01.039
- *Vas'kovskiy V. O., Lepalovskij V. N., Gorkovenko A. N., Savin P. A., Kulesh N. A., Shchegoleva N. N.* Influence of Interlayer Interfaces on Exchange Coupling Efficiency in Multilayer Magnetoresistive Films With Fe50Mn50 Layers // IEEE Tr. Magn. 2014. V. 50, № 11. P. 4800504/1–4. DOI: 10.1109/TMAG.2014.2327131
- *Vas'kovskiy V. O., Svalov A. V., Kurlyandskaya G. V.* Magnetism in Rare Earth – Transition Metal Multilayers// Encyclopedia of Nanoscience and Nanotechnology, edited by H.S. Nalwa (American Scientific Publishers). 2011. V. 16. P. 75–98.

MAGNETIC STRUCTURES AND MAGNETIC PHASE TRANSITIONS

Department of Magnetism and Magnetic Nanomaterials

The objective of the program is the study of the structural state and magnetic properties of graphene composites and 3d-transition metals using the methods of neutron diffraction, neutron reflectometry and small-angle neutron scattering.

Dr. Aleksandr Pirogov
Researcher, Professor

A.N.Pirogov@urfu.ru

Research interests:

- Structure state and magnetic properties of composites formed from multilayered graphene and 3d-transitional metals.

Main publications:

- *Seongsu Lee, Pirogov A., Misun Kang, Kwang-Hyun Jang, Yonemura M., Kamiyama T., Cheong S-W., Gozzo F., Namsu Shin, Kimura H., Noda Y., Park J-G.* Giant magneto-elastic coupling in multiferroic hexagonal manganites // Nature. 2008. 4516. P. 805–809.
  DOI: 10.1038/nature06507
- *Pirogov A. N., Bogdanov S. G., Seongsu Lee, Park J-G., Choi Y-N., Lee H., Grigorev S. V., Sikolenko V. V., Sherstobitova E. A., Schedler R.* Determining the magnetic ground state of $TbNi_5$ single crystal using polarized neutron scattering technique // J. Mag. Mag. Mater. 2012. 324. P. 3811–3816.
  DOI: 10.1016/j.jmmm.2012.06.019
- *Bykov A. A., Chetverikov Yu. O., Pirogov A. N., Grigorev S. V.* Quasi-two dimentional character of magnetic transition order-disorder in YMn_6Sn_6 // Letter to JETP. 2015. V. 101. Is. 10.

Entry requirements:

- Knowledge of background of X-ray, nuclear and magnetic scattering of neutrons.

PHYSICAL BASES OF MAGNETIC PROPERTIES OPTIMIZATION FOR SOFT MAGNETIC MATERIALS

Department of Magnetism and Magnetic Nanomaterials

The program focuses on the study of the magnetic properties of crystalline, amorphous and nanocrystalline soft magnetic materials subjected to mechanical, thermal and corrosive influences.

Dr. Nadezhda Skulkina
Professor, Department of General and Molecular Physics

nadezhda.skulkina@urfu.ru

Research interests:

- Physical bases of magnetic properties optimization for soft magnetic materials.

Main publications:

- *Skulkina N. A., Ivanov O. A.* Soft magnetic materials. Physical effects and magnetic properties // Lap Lambert Academic Publishing, 2010. 404 p.
- *Skulkina N. A., Ivanov O. A., Pavlova I. O, Minina O. A.* Time of Isothermal Holding in the Course of In-Air Heat Treatment of Soft Magnetic Fe-Based Amorphous Alloys and Their Magnetic Properties // Fizika Metallov I Metallovedenie. 2011. V. 112, № 6. P. 583–588.
  DOI: 10.1134/S0031918X11060111
- *Skulkina N. A., Ivanov O. A., Pavlova I. O., Minina O. A.* Interaction of Surface of Ribbonsof Amorphous Soft_MagneticIron_Based Alloys with Vapor // Fizika Metallov I Metallovedenie. 2014. V. 115, № 6. P. 529–537.
  DOI: 10.1134/S0031918X14060131

PHYSICS OF FERROELECTRICS AND RELATED MATERIALS

Department of Computational Physics

This program focuses on the experimental study of the ferroelectric domain structure, kinetics of the phase transformations and domain engineering, among other topics. The students will have access to modern analytical and technological equipment. The Department staff is very friendly and you will have the opportunity to try over a hundred different types of green tea.

Dr. Vladimir Shur
Professor, Director of
Ural Center of Shared Use
"Modern Nanotechnology"

vladimir.shur@urfu.ru

Research interests:

- Experimental study of the ferroelectric domain structure, kinetics of the phase transformations, domain engineering etc.

Main publications:

- *Ievlev A. V., Jesse S., Morozovska A. N., Strelcov E., Eliseev E. A., Pershin Y. V., Kumar A., Shur V. Ya., Kalinin S. V.* Intermittency, Quaziperiodicity, and Chaos during Scanning Probe Microscopy Tip-induced Ferroelectric Domain Switching // Nature Physics. 2014. V. 10. P. 59–66.
  DOI: 10.1038/nphys2796
- *Ievlev A. V., Morozovska A. N., Eliseev E. A., Shur V. Ya., Kalinin S. V.* Ionic Field Effect and Memristive Phenomena in Single-point Ferroelectric Domain Switching // Nature Communications. 2014. V. 5, Article number: 4545.
  DOI: 10.1038/ncomms5545
- *Ievlev A., Alikin D., Morozovska A., Varenyk O., Eliseev E., Kholkin A., Shur V., Kalinin S.* Symmetry Breaking and Electrical Frustration during Tip-Induced Polarization Switching in the Non-Polar Cut of Lithium Niobate Single Crystals // ACS Nano. 2015. V. 9, № 1. P. 769–777.
  DOI: 10.1021/nn506268g

Entry requirements:

- Experience in experimental research in the field of materials science.

MULTICOMPONENT CHALCOGENIDES WITH ELECTRON-IONIC TRANSFER AT HIGH PRESSURES IN WIDE TEMPERATURE RANGE

Department of Low Temperature Physics

The program focuses on the research of physical properties of multicomponent chalcogenides with electron-ionic transfer. The students will be able to participate in different research projects.

Dr. Alexey Babushkin
Head of Department,
Professor

Alexey.babushkin@urfu.ru

Research interests:

- Experimental solid-state physics, the study of the extreme influence (low temperatures, high-pressures, intense heat fluxes) on physical properties of solids.
- Research of physical properties multicomponent chalcogenides with electron-ionic transfer in wide interval of temperatures and pressure.
- Technique of megabar range pressure in diamond anvil cell.

Main publications:

- *Babushkin A. N.* Electrical conductivity and thermal EMF of CsI at high pressures // High Pressure Research. 1991. 6. P. 349–356.
  DOI: 10.1080/08957959208201042
- *Babushkin A. N.* Structural Transformations in Single-Wall Carbon Nanotubes under High Pressure Bulletin of the Russian Academy of Sciences // Physics. 2014. V. 78, № 4. P. 285–287 (with co-authors).
  DOI: 10.3103/S1062873814040327
- *Babushkin A. N.* Impedance spectroscopy of the synthetic proustite at high pressure Bulletin of the Russian Academy of Sciences // Physics. 2013. V. 77, № 3. P. 252–255 (with co-authors).
  DOI: 10.3103/S1062873813030271

Entry requirements:

- Experience in experimental research.

DYNAMICAL EVOLUTION OF EXTRASOLAR PLANETARY SYSTEMS

Department of Astronomy and Geodesy

The program's aim is the construction of semi-analytical theories of motion, the research of long-time dynamical evolution of extrasolar planetary systems and of the orbital evolution stability, as well as the determination of stochastic properties of motion and the application of the obtained results to real extrasolar systems.

Dr. Eduard Kuznetsov
Head of Department

Eduard.Kuznetsov@urfu.ru

Research interests:

- Research of orbital evolution of planets and artificial satellites of the Earth.

Main publications:

- *Kuznetsov E. D., Zakharova P. E.* Dynamical evolution of space debris on high-elliptical orbits near high-order resonance zones // Advances in Space Research. 2015.
  DOI: 10.1016/j.asr.2015.03.022
- *Kholshevnikov K. V., Kuznetsov E. D.* Stability of planetary systems with respect to masses // Celestial Mechanics and Dynamical Astronomy. 2011. V. 109. P. 201–210.
  DOI: 10.1007/s10569-010-9324-0

Entry requirements:

- Knowledge in Celestial Mechanics.
- Programming skills in Fortran or C++.

EARLY STAGES OF STELLAR EVOLUTION AND MASERS

Department of Astronomy and Geodesy

The aim of the program is the analysis of observational data obtained with state of the art instruments on the early stages of star formation and/or theoretical modelling.

Dr. Andrey Sobolev
Chief Scientific Researcher

Andrej.Sobolev@urfu.ru

Research interests:

- Masers, star formation, early stages of stellar evolution, radioastronomy.

Main publications:

- Kardashev et al. (including Sobolev) Review of scientific topics for Millimetron space observatory // Physics – Uspekhi. 2014. 57 (12). DOI: 10.3367/UFNe.0184.201412c.1319
- Richards et al. (including Sobolev) ALMA sub-mm maser and dust distribution of VY Canis Majoris. DOI: 10.1051/0004-6361/201425024
- Parfenov, Sobolev. On the Class II methanol maser periodic variability due to the rotating spiral shocks in the gaps of discs around young binary stars. // Monthly Notices of the Royal Astronomical Society. 2014. 444. Is. 1. P. 620–628. DOI: 10.1093/mnras/stu1481

LATE STAGES OF STELLAR EVOLUTION AND MASERS

Department of Astronomy and Geodesy

The program focuses on the analysis of observational data obtained with state of the art instruments on the late type stars.

Dr. Junichi Nakashima
Professor

Nakashima.Junichi@urfu.ru

Research interests:

- Masers, late stages of stellar evolution, radioastronomy.

Main publications:

- Nakashima et al. CO Structure of the 21 μm Source IRAS 22272+5435: A Sign of a Jet Launch // Astrophysical journal. 2012. 759.
  DOI: 10.1088/0004-637X/759/1/61
- Nakashima et al. Maser Properties of the Enigmatic IRAS Source 19312+1950. // Astrophysical Journal. 2011. 728.
  DOI: 10.1088/0004-637X/728/2/76
- Nakashima et al. Three-dimensional Structure of the Central Region of NGC 7027: A Quest for Trails of High-velocity Jets // Astrophysical Journal. 2010. 140. Is. 2. P. 490–499.
  DOI: 10.1088/0004-6256/140/2/490

MODEL THEORETICAL APPROACHES TO STRONGLY CORRELATED ELECTRON SYSTEMS

Department of Theoretical Physics

The fields studied in this program are (pseudo)spin algebra, atoms in crystals; exchange interactions; (pseudo)spin Hamiltonians; Bose-Hubbard models; phase diagrams; topological defects; the Monte-Carlo technique and computer modeling.

Dr. Alexander Moskvin
Head of the Department of Theoretical Physics, Professor

alexander.moskvin@urfu.ru

Research interests:

Condensed matter theory – model theoretical approaches to strongly correlated electron systems:

- (Pseudo)spin algebra.
- (Pseudo)spin Hamiltonians.
- Bose-Hubbard models.
- Atoms in crystals.
- Microscopic theory of magnetic, optical and resonance properties of 3d compounds.
- Exchange interactions.

Main publications:

- Moskvin A. S. and S.-L. Drechsler. Microscopic mechanisms of spin-dependent electric polarization in 3d oxides // Phys. Rev. 2008. B 78, 024102. DOI: 10.1103/PhysRevB.78.024102
- *Moskvin A. S.* True charge transfer gap in parent insulating cuprates // Phys. Rev. 2011. B84, 075116. DOI: 10.1103/PhysRevB.84.075116
- Moskvin A.S. et al., Direct evidence of the non-Zhang-Rice Cu3+ centers in La2Li0.5Cu0.5O4 // Phys. Rev. 2012. B 86, 241107(R). DOI: 10.1103/PhysRevB.86.241107
- *Moskvin A. S.* Perspectives of disproportionation driven superconductivity in strongly correlated 3d compounds // J. Phys.: Condens. Matter. 2013. 25 085601. 16 p. DOI: 10.1088/0953-8984/25/8/085601

MODELING THE CALCIUM DYNAMICS IN CARDIAC CELLS

Department of Theoretical Physics

The fields studied in this program are molecular and cell biophysics; electron-conformational theory of proteins; ion dynamics in cells and computer modeling of calcium dynamics.

Dr. Alexander Moskvin
Head of the Department of Theoretical Physics, Professor

alexander.moskvin@urfu.ru

Research interests:

Biophysics – Modeling the calcium dynamics in cardiac cells:

- Molecular and cell biophysics.
- Electron-conformational theory of proteins.
- Ion dynamics in cells.
- Computer modeling of calcium dynamics.

Main publications:

- *Moskvin A. S., Philipiev M. P., Solovyova O. E., Kohl P., Markhasin V. S.* Electron-conformational model of ryanodine receptor lattice dynamics // Progress in Biophysics and Molecular Biology. 2006. 90. P. 88–103. DOI: 10.1016/j.pbiomolbio.2005.06.007
- *Moskvin A. S., Ryvkin A. M., Solovyova O. E., Markhasin V. S.* Electron-conformational transformations in nanoscopic RyR channels govern both the heart's contraction and beating // JETP Letters. 2011. 93 (7). P. 403–408. DOI: 10.1134/S0021364011070083

SEMICONDUCTOR PHYSICS

Department of Computational Physics

The program involves studying the physical properties of semiconductor materials and semiconductor-based composite structures. The research activity relates to studying the energy spectra and electron transport in HgCdTe-based heterostructures.

Dr. Alexander Germanenko
Head of Department

alexander.germanenko@urfu.ru

Research interests:

- Energy spectrum and transport in semiconductor A3B5, A2B6 heterostructures with two-dimensional electron and hole gas.

Main publications:

- *Minkov G. M., Germanenko A. V., Rut O. E., Sherstobitov A. A., Dvoretski S. A., Mikhailov N. N.* Anisotropic conductivity and weak localization in HgTe quantum wells with a normal energy spectrum // Phys. Rev. 2013. B 88, 045323. DOI: 10.1103/PhysRevB.88.045323
- *Minkov G. M., Germanenko A. V., Rut O. E., Sherstobitov A. A., Dvoretsk S. A., Mikhailov N. N.* Two-dimensional semimetal in a wide HgTe quantum well: Magnetotransport and energy spectrum // Phys. Rev. 2013. B 88, 155306. DOI: 10.1103/PhysRevB.88.155306
- *Minkov G. M., Germanenko A. V., Rut O. E., Sherstobitov A. A., Dvoretski S. A., Mikhailov N. N.* Hole transport and valence-band dispersion law in a HgTe quantum well with a normal energy spectrum // Phys. Rev. 2014. B 89, 165311.
DOI: 10.1103/PhysRevB.89.165311

Entry requirements:

- Preferably experimental physicist.

MAGNETISM OF CHIRAL HELIMAGNETS

Department of Theoretical Physics

The program's aim is to study magnetic properties of monoaxial chiral helimagnets and to carry out theoretical analysis of their functionality in spintronics applications.

Dr. Alexander Ovchinnikov
Professor

alexander.ovchinnikov@urfu.ru

Research interests:

- Magnetism of low-dimensional magnetic systems, chiral helimagnets, renormalization group.

Main publications:

- *Kishine J., Bostrem I. G., Ovchinnikov A. S., Sinitsyn Vl. E.* Coherent sliding dynamics and spin motive force driven by crossed magnetic fields in a chiral helimagnet // Phys. Rev. 2012. B 86, 214426.
  DOI: 10.1103/PhysRevB.86.214426
- *Kishine J., Proskurin I. V., Ovchinnikov A. S.* Tuning Magnetotransport through a Magnetic Kink Crystal in a Chiral Helimagnet // Phys. Rev. Lett. 2011. 107, 017205.
  DOI: 10.1103/PhysRevLett.107.017205
- *Togawa Y., Koyama T., Takayanagi K., Mori S., Kousaka Y., Akimitsu J., Nishihara S., Inoue K., Ovchinnikov A. S., Kishine J.* Chiral Magnetic Soliton Lattice on a Chiral Helimagnet// Phys. Rev. Lett. 2012. 108, 107202.
  DOI: 10.1103/PhysRevLett.108.107202

CONDENSED MATTER PHYSICS. PHYSICS OF MAGNETIC PHENOMENA

Department of Condensed Matter Physics

This program focuses on the synthesis of transition metal chalcogenides with layered structure and experimental study of their crystal structure and physical properties. The students will have the opportunity to participate in different research projects.

Dr. Nikolai Baranov
Head of Department,
Professor

n.v.baranov@urfu.ru

Research interests:

- Crystal structure, phase transitions, transport and magnetic properties of the rare-earth and transition metals compounds.

Main publications:

- *Baranov N. V. et al.* Enhanced survival of short-range magnetic correlations and frustrated interactions in R 3T intermetallics // Journal of Magnetism and Magnetic Materials. 2012. 324 (2012). 1907–1912.
  DOI: 10.1016/j.jmmm.2012.01.021
- *Baranov N. V. et al.* Magnetic order, field-induced phase transitions and magnetoresistance in the intercalated compound Fe0.5TiS2 // J. Physics: Condensed Matter. 2013. 25 (2013). 066004.
  DOI: 10.1088/0953-8984/25/6/066004
- *Baranov N. V. et al.* Crystal structure, phase transitions and magnetic properties of pyrrhotite-type compounds Fe7-xTixS8 // Physica B: Condensed Matter. 2014. 449 (2014). 229–235.
  DOI: 10.1016/j.physb.2014.05.040

Entry requirements:

- Master's Degree in Condensed Matter Physics or Physics of Magnetic Phenomena.

THERMOPHYSICS AND THEORETICAL THERMOTECHNICS

Department of General and Molecular Physics

The program will focus on the following topics: the kinetic theory of motion of rarefied single-component gases and gas mixtures in capillaries under the influence of pressure, temperature and concentration gradients, as well as resonant optical radiation; kinetic theory of motion of fine aerosols in inhomogeneous gases. During the program we will be using analytical and numerical methods for solving the Boltzmann equation.

Dr. Vladimir Chernyak
Head of Department

vladimir.chernyak@urfu.ru

Research interests:

- Kinetic theory of transport processes in the rarefied gases: capillary gas flows, evaporation and condensation, aerosols motion, etc.

Main publications:

- *Chernyak V. G., Polikarpov A. P.* Light induced drift and heat transfer of one-component gas in a capillary // Journal of Statistical Physics. 2010. V. 140. P. 504–517.
  DOI: 10.1007/s10955-010-0001-1
- Chermyaninov I. V., Chernyak V. G. Thermo-optical pressure difference in one-component gas // Physics of Fluids. 2014. V. 26, № 9. P. 092001.
  DOI: 10.1063/1.4894200

Entry requirements:

- Basic knowledge of hydrodynamics and kinetic theory of gases.
- Basic knowledge of numerical methods for solving differential equations.

THERMODYNAMIC AND KINETIC PROPERTIES OF SEMICONDUCTORS WITH IMPURITIES OF TRANSITION ELEMENTS

Department of Theoretical Physics

The program focuses on theoretical studies of thermodynamic and kinetic properties of semiconductors with impurities of transition elements (spin polarization, temperature and concentration dependencies of heat capacity, magnetic susceptibility, elastic modulus, anomalous Hall effect, conductivity).

Dr. Evgeny Pamyatnykh
Professor

Evgeny.Pamyatnykh@urfu.ru

Research interests:

- Thermodynamic and kinetic properties of metals and semiconductors with electron-electron interaction taken into account.
- Low-temperature magnetic quantum oscillation effects in a quantizing magnetic field.
- Quantum waves in metals and semiconductors.

Main publications:

- *Okulov V., Pamyatnykh E., Zabaznov Yu.* Theory of spontaneous spin polarization of impurity hybridized states of electrons // Bulletin of the Russian Academy of Sciences: Physics. 2013. V. 77, № 10. P. 1524–1527.
- *Pamyatnykh E. A., Ursulov A. V.* Nonlinear solitary waves in nonlocal elastic solids // Acoustical Physics. 2012. V. 58 (2). P. 160–165. DOI: 10.1134/s1063771012010162
- *Okulov V. I., Pamyatnykh E. A., Silin V. P.* Spontaneous spin polarization of systems with impurity hybridized electron states in conduction band of crystals // Low Temperature Physics. 2011. V. 37 (10). P. 798–802. DOI: 10.1063/1.3670020

ISOTOPIC FEATURES OF ATMOSPHERIC WATER CYCLE IN ARCTIC

Department of General and Molecular Physics

The focus of this program is remote sensing and in situ measurements of water vapor isotopes in the atmosphere of the Arctic and the sub-Arctic. In addition, the analysis of the obtained time series data will be carried out and the data with outputs of isotope general circulation model ECHAM-iso will be compared.

Dr. Vyacheslav Zakharov
Head of Laboratory, Professor

v.zakharov@remotesensing.ru

Research interests:

- Climate and environmental physics.
- Remote sensing of trace gases in the atmosphere using high-resolution satellite and ground-based spectrometers in infrared.
- Satellite data validation using ground-based observation.
- Water vapor isotopes monitoring in boundary layer of the atmosphere.
- Water isotopes measurements in atmospheric precipitation.

Main publications:

- *Zakharov V. I., Imasu R., Gribanov K. G., Hoffmann G., Jouzel J.* Latitudinal distribution of deuterium to hydrogen ratio in the atmospheric water vapor retrieved from IMG/ADEOS data // Geophys. Res. Lett. 2004. V. 31, № 12. P. 723–726. DOI: 10.1029/2004GL019433
- *Rokotyan N. V., Zakharov V. I., Gribanov K. G., Schneider M., Bréon F. M., Jouzel J., Imasu R., Werner M., Butzin M., Petri C., Warneke T., Notholt J.* A posteriori calculation of d18O and dD in atmospheric water vapour from ground-based near infrared FTIR retrievals of H2160, H2180, and HD160 // Atmospheric Measurement Techniques. 2014. 7 (8). P. 2567–2580. DOI: 10.5194/amt-7-2567-2014
- *Gribanov K., Jouzel J., Bastrikov V., Bonne J. L., Breon F. M., Butzin M., Cattani O., Masson-Delmotte V., Rokotyan N., Werner M., Zakharov V.* Developing a western Siberia reference site for tropospheric water vapour isotopologue observations obtained by different techniques (in situ and remote sensing) // Atmospheric Chemistry and Physics. 2014. 14 (12). P. 5943–5957. DOI: 10.5194/acp-14-5943-2014

CONDENSED MATTER PHYSICS. PHYSICS AND NANOSTRUCTURE TECHNOLOGY

Laboratory of Electron microscopy and Department of Low Temperature Physics

Crystal and amorphous structure, defects and transformations. Thin Film syntheses, growth and transitions. Crystallography, transmission electron microscopy and diffraction. Nanostructures and nanomaterials.

Dr. Vladimir Kolosov

Head of Laboratory of Electron Microscopy, PhD, Prof. of Low-temperature Physics Dept.

kolosov@urfu.ru

Research interests:

- Formation, growth and transformations of thin films and crystals.
- Transmission electron microscopy of novel aperiodic, transrotational crystals and nanostructures formed in amorphous films.

Main publications:

- Transmission electron microscopy studies of the specific structure of crystals formed by phase transition in iron oxide amorphous films /Kolosov V. Yu., Thölén A. R. Acta Mater. (2000) 48. P. 1829–1840. DOI: 10.1016/S1359-6454(99)00471-1
- Combined AFM-TEM studies of amorphous-crystalline transformation and interface in thin films of Se and Fe2O3 /Kolosov V. Yu. et.al., Journal of Physics: Conference series, V. 100 (2008) 082037 (4pp). DOI:10.1088/1742-6596/100/8/082037
- "Transrotation" revealed by electron diffraction: perfect crystal in curved space V. Yu. Kolosov, Acta Crystallographica Section A, 2011. V. 67. P. 695. HTTP://journals.iucr.org/a/issues/2011/a1/00/a48359/a48359.pdf

Entry requirements:

- University education: Physics, Materials Science, Nanoscience & Technology, Chemistry.

FACULTY OF CHEMISTRY

Anna Guseva
Director of the Faculty

Anna.Guseva@urfu.ru

About the Faculty

UrFU Faculty of Chemistry gives its students the necessary skills and knowledge to work in the fields of research, education or industry after graduation. The available degrees are Chemistry; Fundamental and Applied Chemistry; Chemistry, Physics and Mechanics of Materials.

During their studies the students are allowed to choose one of the following specialization profiles: "Organic Chemistry", "Inorganic Chemistry", "Analytical Chemistry", "Solid State Chemistry", "Macromolecular Compounds", "Physical Chemistry", and "Environmental Chemistry, Chemical Expertise and Environmental Safety".

Department	Head of Department
Department of Inorganic Chemistry	Irina Animitsa irina.animitsa@urfu.ru
Department of Organic Chemistry	Vyacheslav Sosnovskikh vy.sosnovskikh@urfu.ru
Department of Analytical Chemistry	Ludmila Neudachina Ludmila.Neudachina@urfu.ru
Department of High Molecular Compounds	Sergey Vshivkov sergey.vshivkov@urfu.ru
Department of Physical Chemistry	Vladimir Cherepanov v.a.cherepanov@urfu.ru

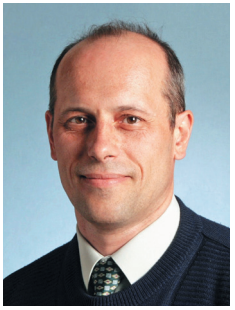
The Departments of the Faculty of Chemistry are equipped with modern instruments and devices, such as:

- X-ray diffractometers for structural investigations: EQUINOX 3000, Enel; XRD 7000S, Shimadzu both equipped with high temperature cameras;
- Instruments for thermodynamic and thermal analysis measurements: DynTherm LP-ST, Rubotherm; Simultaneous Thermal Analyzer STA 409 PC Luxx, Netzsch; Thermogravimetric Analyzer PYRIS I TGA, Perkin Elmer; Calve calorimeter, Seteram;
- Apparatus for the thermomechanical properties measurements: Dilatometer DIL402C, Netzsch; thermomechanical analyzer TMA 202/1/G, Netzsch;
- Instruments for chemical analysis: Inductively Coupled Plasma Atomic Emission Spectrometer iCAP 6500 Duo, Thermo Scientific; Atomic Absorption Spectrometer SOLAAR M6, Thermo Scientific; Fourier Transform Infrared Spectrometer with Expanded Spectral Range Nicolet 6700, Thermo Scientific.

MAGNETIC POLYMERIC COMPOSITES AND FERROGELS

Department of Polymers

The program focuses on the thermodynamic study of the enthalpy of interfacial interaction between magnetic metal and metal oxide nanoparticles with polymer matrices in composites and ferrogels, analysis of magnetic properties, magnetostriction, relaxation.



Dr. Alexander Safronov
Professor

Alexander.Safronov@urfu.ru

Research interests:

- Thermodynamics of multicomponent polymer systems, polymer solutions, gels, composites and nanocomposites.
- Thermodynamic modeling of molecular interactions.
- Polyelectrolyte gels.
- Stabilization and stability of colloid suspensions of nanoparticles.
- Composite materials based on metal and metal oxide nanoparticles including magnetic nanoparticles

Main publications:

- *Safronov A. P., Kurlyandskaya G. V., Chlenova A. A., Kuznetsov M. V., Bazhin D. G., Beketov I. V., Sanchez-Ilarduya M., Martinez-Amesti A.* Carbon deposition from aromatic solvents onto active intact 3d metal surface at ambient conditions // Langmuir. 2014. 30 (11). P. 3243–3253.
  DOI: 10.1021/la4049709
- *Safronov A. P., Shakhnovich M., Kalganov A., Kamalov I. A., Shklyar T. F., Blyakhman F. A., Pollack G. H.* DC Electric Fields Produce Periodic Bending Of Polyelectrolyte Gels // Polymer. 2011. 52. P. 2430–2436.
  DOI: 10.1016/j.polymer.2011.03.048

Entry requirements:

- Knowledge of chemistry and physics of polymers and colloids.

PHYSICAL CHEMISTRY OF OXIDE SYSTEMS: THERMODYNAMICS, STRUCTURE, PROPERTIES

Department of Physical Chemistry

The program includes an immersed study of the physicochemical basis of preparation, research and application of solid oxide materials by both experimental and theoretical approaches.

Dr. Vladimir Cherepanov
Principal Investigator,
Head of the Department
of Physical Chemistry

v.a.cherepanov@urfu.ru

Research interests:

- Research of complex oxides perspective for the various applications as electrode, catalytic, membrane or sensor materials: thermodynamic stability, phase equilibria, crystal and defect structure, oxygen nonstoichiometry, functional electrotransport properties.

Main publications:

- *Volkova N. V., Lebedev O. I., Gavrilova L. Ya., Turner S., Gauquelin N., Motin Seikh Md., Caignaert V., Cherepanov V. A., Raveau B., Van Tendeloo G.* Nanoscale Ordering in Oxygen Deficient Quintuple Perovskite $Sm_{2-\varepsilon}Ba_{3+\varepsilon}Fe_5O_{15-\delta}$: Implication for Magnetism and Oxygen Stoichiometry // Chem. Mater. 2014. V. 26. Is. 21. P. 6303–6310.
  DOI: 10.1021/cm503276p
- *Urusova A. S., Cherepanov V. A., Lebedev O. I., Aksenova T. V., Gavrilova L. Ya., Caignaert V., Raveau B.* Tuning oxygen content and distribution by substitution at Co site in 112 $YBaCo_2O_{5+\delta}$. Impact on transport and thermal expansion properties. // J. Mater. Chem. A. 2014. V. 2. Is. 23. P. 8823–8832.
  DOI: 10.1039/C4TA01264J
- *Urusova A. S., Cherepanov V. A., Aksenova T. V., Gavrilova L. Ya., Kiselev E. A.* Phase equilibria, crystal structure and oxygen content of intermediate phases in the Y – Ba – Co – O system. // J. Solid State Chem. 2013. V. 202. P. 207–214.
  DOI: 10.1016/j.jssc.2013.03.037

Entry requirements:

- Good experimental skills: synthesis of solid materials, organization of physicochemical experiment.
- Basic knowledge of crystal chemistry, chemical thermodynamics, chemical kinetics, electrochemistry.
- Thoroughness, reliability, efficiency.

FUNDAMENTAL PRINCIPLES OF CHEMICAL DESIGN FOR NOVEL MULTIFUNCTIONAL MATERIALS ON THE BASIS OF PEROVSKITE-LIKE OXIDES

Department of Physical Chemistry

The aim of the program is the comprehensive study of real (crystal and defect) structure and related properties of advanced complex oxide materials.

Dr. Andrey Zuev
Professor

andrey.zuev@urfu.ru

Research interests:

- Study of target properties of advanced complex oxide materials in relation with their crystal and defect structure.

Main publications:

- *Tsvetkov D. S., Ananjev M. V., Eremin V. A., Zuev A. Yu., Kurumchin E. Kh.* Oxygen nonstoichiometry, defect structure and oxygen diffusion in the double perovskite GdBaCo2O6–δ // Dalton Transaction. 2014. V. 43. P. 15937–15943. DOI: 10.1039/C4DT01486C
- *Zuev A. Yu.,Sereda V. V., Tsvetkov D. S.* Defect structure and defect-induced expansion of doped perovskite La0.7Sr0.3Co0.9Fe0.1O3-δ // International Journal of Hydrogen Energy. 2014. V. 39. P. 21553–21560. DOI: 10.1016/j.ijhydene.2014.09.115
- *Sereda V. V., Tsvetkov D. S., Ivanov I. L., Zuev A. Yu.* Oxygen nonstoichiometry, defect structure and related properties of $LaNi_{0.6}Fe_{0.4}O_{3-\delta}$ // Journal of Materials Chemistry A. 2015. V. 3, № 11. P. 6028–6037. DOI: 10.1039/c4ta05882h

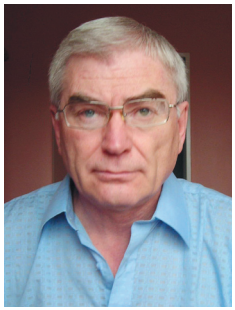
Entry requirements:

- Basic knowledge in Physical Chemistry and elementary knowledge in Solid State Chemistry.
- Elementary skills in oxide materials preparation.

HETEROCYCLIC CHEMISTRY

Department of Organic Chemistry

The program focuses on the syntheses of heterocycles on the basis of CF3-containing synthons.



Dr. Vyacheslav Sosnovskikh
Head of Department,
Professor

vy.sosnovskikh@urfu.ru

Research interests:

- Synthesis and reactivity of CF3-synthons on the basis of oxygen-containing heterocycles and nitroalkenes.

Main publications:

- *Irgashev R. A., Safrygin A. V., Ezhikova M. A., Kodess M. I., Röschenthaler G.-V., Sosnovskikh V. Y.* Synthesis of 2-(trifluoroacetyl)chromones and their reactions with 1,2-diamines // TETRAHEDRON. 2015. 71. P. 1822–1830. DOI: 10.1016/j.tet.2015.02.010
- *Sosnovskikh V. Y., Korotaev V. Y., Barkov A. Y., Kutyashev I. B., Safrygin A. V.* One-pot domino synthesis of polyfunctionalized benzophenones, dihydroxanthones, and m-terphenyls from 2-(polyfluoroalkyl) chromones // EUROPEAN JOURNAL OF ORGANIC CHEMISTRY. 2015. P. 1932–1944. DOI: 10.1002/ejoc.201403585
- *Savych I., Glasel T., Villinger A., Sosnovskikh V. Y., Iaroshenko V. O., Langer P.* Synthesis of functionalized 2-salicyloylfurans, furo[3,2-b]chromen-9-ones and 2-benzoyl-8H-thieno[2,3-b]indoles by one-pot cyclizations of 3-halochromones with β-ketoamides and 1,3-dihydroindole-2-thiones // ORGANIC & BIOMOLECULAR CHEMISTRY. 2015. 13. P. 729–750. DOI: 10.1039/c4ob01730g

Entry requirements:

- Deep knowledge of organic chemistry.

PROTON CONDUCTING OXIDE CERAMIC MATERIALS FOR APPLICATIONS IN MEDIUM TEMPERATURE ELECTROCHEMICAL DEVICES

Department of Inorganic Chemistry

The program focuses on the synthesis, crystal and local structure, thermal and electrical properties, chemical stability of the high-temperature proton conductors with perovskite structure.

Dr. Irina Animitsa
Head of the Department of Inorganic Chemistry, Professor

irina.animitsa@urfu.ru

Research interests:

- Materials science; inorganic materials chemistry, solid-state electrochemistry, ionics.
- Advanced ceramic materials, mainly oxides; their defect structure, diffusivity, electrical properties and electrochemistry at high temperatures.
- Hydrogen defects.
- Solid electrolytes (oxygen ion and proton conductors).

Main publications:

- *Tarasova N., Animitsa I.* Novel proton-conducting oxyfluorides $Ba_{4-0.5x}In_2Zr_2O_{11-x}F_x$ with perovskite structure // Solid State Ionics. 2014. 264. P. 69–75.
  DOI: 10.1016/j.ssi.2014.06.021.
- *Tarasova N. A., Zhuravlev N. A., Animitsa I. E., Denisova T. A., Baklanova Ya. V., Kavun V. Ya.* Features of the Local Structure of Hydrated Fluorine-Substituted Solid Solutions Based on $Ba_2In_2O_5$ // Bulletin of the Russian Academy of Sciences. Physics. 2014. 78 (8). P. 730–732.
  DOI: 10.3103/S1062873814080371.

Entry requirements:

- Knowledge of synthesis of complex oxides by solid state route, impedance spectroscopy, Rietveld refinement.

INSTITUTE OF MATHEMATICS AND COMPUTER SCIENCE

Mathematics is an eternally young science, which over the last decade has gained new impetus for development through the widespread introduction of computer technologies in various spheres of human activity. A high quality education in mathematics and computer science is appreciated all over the world, and the demand for top-level of specialists grows every year.

We invite all researchers interested in mathematics, mathematical and computer modeling, and theoretical computer science to pursue their doctoral studies in the Institute of Mathematics and Computer Science, Ural Federal University.

The Institute of Mathematics and Computer Science is a leader in research among the UrFU Institutes in terms of the numbers of research projects and publications in world-class journals. The Institute offers a stimulating environment and the necessary infrastructure for the successful completion of doctoral programs. The thesis advisors involved with the doctoral programs are leading researchers in their fields and have broad experience of working in the best universities in Russia and all over the world.

Magaz Asanov,
Director of the IMCS

ABOUT THE INSTITUTE

Ural Federal University

named after the first President of Russia B.N.Yeltsin

Institute of Mathematics and Computer Sciences

The Institute of Mathematics and Computer Science (IMCS) is one of the leading organizations in Russia in the field of pure mathematics, applied mathematics, and theoretical computer science. The key areas of research in the IMCS include extremal problems in the theory of functions and operators, stochastic differential-operator problems, ill-posed problems, numerical methods for functional differential equations, mathematical modeling in physiology and medicine, mathematical and computer modeling of complex fluids, structural and algorithmic problems for semigroups, groups, lattices and rings, finite automata, combinatorics of words, graph theory and machine learning.

The Institute has at its disposal a next-generation, high-performance IT equipment, as well as an access to the computing resources of the Institute of Mathematics and Mechanics, Ural Branch of the Russian Academy of Sciences.

Many of the Institute's PhD graduates find employment in the Institutes of the Russian Academy of Sciences, research laboratories of industrial corporations, and other science-intensive businesses. Also, the graduates work successfully in high-tech industries, including some of the World's largest computer companies such as Yandex, Google and Microsoft.

DOCTORAL STUDIES AT THE IMCS

The IMCS offers a wide range of Doctoral Programs in the fields of:

- Mathematics and Mechanics.
- Computer and Information Sciences.
- Computer Science and Engineering.

In this brochure you will find a brief description of the Doctoral Programs, alongside with information about the thesis advisors.

We offer:

- 3 or 4 year Doctoral Programs resulting in the defense of either a Candidate of Science thesis or a UrFU PhD thesis.
- Accommodation in a University dormitory.
- The possibility to take additional employment as a researcher in the group of your thesis advisor.
- Russian language courses.

Entry requirements:

- Master's Degree in a field related to the field of Doctoral Studies.
- Intermediate level of English or Russian (B2).
- Interview.

For further information, please contact:

Ekaterina Elfimova
Ekaterina.Elfimova@urfu.ru

EXTREMAL PROBLEMS OF THEORY OF FUNCTIONS AND OPERATORS

Department of Mathematical Analysis and Function Theory

The fields studied in this program include extremal problems for differentiable functions, approximation of unbounded operators by bounded ones on sets of functions of one and many variables, various properties of polynomials and entire functions, in particular, inequalities for norms of derivatives, positive definite functions and their application in extremal problems for spherical codes.

Dr. Vitalii Arestov
Head of Department, Professor

vitalii.arestov@urfu.ru

http://work.imkn.urfu.ru/arestov/index_en.html

Research interests:

- Extremal problems for polynomials and entire functions.
- Approximation of unbounded operators by bounded ones .
- Positive definite functions and their application in extremal problems for spherical codes.

Main publications:

- *Arestov V. V., Filatova M. A.* Best approximation of the differentiation operator in the space L2 on the semiaxis // Journal of Approximation Theory 187, 65–81 (2014). DOI: 10.1016/j.jat.2014.08.001
- *Arestov V. V., Mendelev A. S.* Trigonometric polynomials of least deviation from zero in measure and related problems // Journal of Approximation Theory 162 (10), 1852–1878 (2010). DOI: 10.1016/j.jat.2010.07.007
- *Arestov V. V.* Approximation of unbounded operators by bounded operators and related extremal problems // Russian Math. Surveys 51 (6), 1093–1126 (1996). DOI: 10.1070/RM1996v051n06ABEH003001
- *Arestov V. V.* On integral inequalities for trigonometric polynomials and their derivatives // Math. USSR Izvestija 18 (1), 1–17 (1982). DOI: 10.1070/IM1982v018n01ABEH001375

Entry requirements:

- Basic knowledge of real and complex analysis.

INEQUALITIES FOR POLYNOMIALS AND ENTIRE FUNCTIONS

Department of Mathematical Analysis and Function Theory

This program focuses on the study of some linear operators (differentiation, interpolation and others) on the sets of polynomials and entire functions in different norm spaces, obtaining generalizations of classical inequalities of Bernstein, Markov, Szego.

Dr. Polina Glazyrina
Associate Professor

polina.glazyrina@urfu.ru

Research interests:

- Approximation theory, extremal problems for polynomials and entire functions, modulus of smoothness, wavelets.

Main publications:

- *Glazyrina P., Tikhonov S.,* Jacobi weights, fractional integration, and sharp Ulyanov inequalities // Journal of Approximation Theory 195, 122–140 (2015). DOI: 10.1016/j.jat.2014.05.005
- *Arestov V. V., Glazyrina P. Yu.,* Sharp integral inequalities for fractional derivatives of trigonometric polynomials // Journal of Approximation Theory 164, 1501–1512 (2012). DOI: 10.1016/j.jat.2012.08.004
- *Glazyrina P. Yu.* The sharp Markov-Nikol'skii inequality for algebraic polynomials in the spaces L_q and L_0 on a closed interval // Mathematical Notes 84 (1), 3–21 (2008). DOI: 10.1134/S0001434608070018.

Entry requirements:

- Basic knowledge of real and complex analysis.

RESEARCH OF PROPERTIES OF TOPOLOGIES OF FUNCTION SPACES

Department of Mathematical Analysis and Function Theory

The set C(X, Y) of all continuous mappings from the Tychonov space X to the uniform space Y has a number of natural topologies like the set-open topology, the uniform convergence topology, the graph topology, but when the space Y has a complementary structure, the set C(X, Y) has interesting and important topologies defined with the use of the Y-space structure. One of the interesting problems is to study the uniform, fine and graph topologies on C(X, Y) where the space Y is a metric space, or, moreover, the Y space is a normed linear space.

Dr. Alexander Osipov
Professor

oab@list.ru

Research interests:

- General topology.
- Function analysis.

Main publications:

- *Osipov A. V., Pytkeev E. G.* On the σ-countable compactness of spaces of continuous functions with the set-open topologyTrudy Inst. Mat. i Mekh. UrO RAN, 19:3 (2013), 251–260. HTTP://www.mathnet.ru/links/93b3916fc4e99e24113a3efab2a12480/timm983.pdf
- *Osipov A. V.* TOPOLOGICAL-ALGEBRAIC PROPERTIES OF FUNCTION SPACES WITH SET-OPEN TOPOLOGIES // Topology and its Applications. 2012. T. 159. № 3. C. 800–805. DOI: 10.1016/j.topol.2011.11.049
- *Osipov A. V.* THE C-COMPACT-OPEN TOPOLOGY ON FUNCTION SPACES // Topology and its Applications. 2012. T. 159. № 13. C. 3059–3066. DOI: 10.1016/j.topol.2012.05.018
- *Osipov A. V.* THE SET-OPEN TOPOLOGY // Topology Proceedings, 2011. C. 205–217. HTTP://elibrary.ru/item.asp?id=16998234
- *Nokhrin S. È., Osipov A. V.* On the coincidence of the set-open and uniform topologies // Trudy Inst. Mat. i Mekh. UrO RAN, 15:2 (2009), 177–184. HTTP://www.mathnet.ru/links/3ad3f792775a9c6a4a43b6ad4b558a76/timm233.pdf

Entry requirements:

- Basic knowledge of general topology and function analysis.

REGULARIZED SOLUTIONS OF STOCHASTIC DIFFERENTIAL-OPERATOR PROBLEMS

Department of Mathematical Analysis and Function Theory

The program is devoted to study of problems for infinite dimensional stochastic equations. The huge interest to the problems is related to the important role of chance factors in the processes surrounding us, especially, in physics, biology, and financial mathematics. Models that give an accurate description of these processes lead to stochastic equations in finite and infinite dimensional spaces.

The program is focused on training specialists in mathematical methods for solving of stochastic problems taking in consideration different random perturbations.

Dr. Irina V. Melnikova
Professor,
Honored Scientist of the Russian Federation

Irina.Melnikova@urfu.ru

Research interests:

- Investigations of the Cauchy problems for stochastic equations in Hilbert spaces.
- Application of semigroup, regularization, and generalized function methods for solving well-posed and ill-posed stochastic problems.
- Study of interrelations between stochastic problems and PDEs for probabilistic characteristics.

Main publications:

- *Melnikova I. V., Filinkov A.* Abstract Cauchy Problems: Three Approaches. Monographs and Surveys in Pure and Applied Mathematics, 120. Chapman&Hall, 2001.
- *Melnikova I. V., Anufrieva U. A.* Peculiarities and regularization of ill-posed Cauchy problems with differential operators // J. of Math. Sciences. 2008. V. 148, № 4. P. 481–632.
  DOI: 10.1007/s10958-008-0012-5
- *Alshansky M. A., Melnikova I. V.* Regularized and generalized solutions of infinite-dimensional stochastic problems // Sbornik: Mathematics. 2011. V. 202, № 11. P. 1565–1592.
  DOI: 10.1070/SM2011v202n11ABEH004199

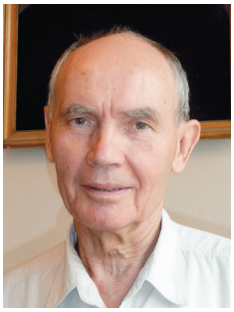
Entry requirements:

- Basic knowledge of functional analysis and probability theory (within the scope of the successfully completed undergraduate program).

THEORY OF REGULARIZATION OF ILL-POSED PROBLEMS AND STABLE METHODS OF THEIR SOLUTION

Department of Computational Mathematics

It is commonly known that the ill-posed problems cannot be solved by the traditional methods of computational mathematics. It is necessary to develop special regularizing algorithms for the stable solution of such problems. The program is focused on the studies of the regularization theory (convergence theorems, error estimates), stable numerical methods of solution, and applying regularizing algorithms in solving the inverse ill-posed problems arising in various fields of natural sciences.



Dr. Vladimir Vasin
Professor

vasin@imm.uran.ru

Research interests:

- Theory of regularization and discrete approximation of ill-posed problems.
- Special iterative methods for solving inverse problems taking into account all a priori information on the desired solution.
- Reconstruction of solutions with various types of singularities for linear operator equations.
- Applications of regularizing algorithms to inverse problems arising in natural sciences.

Main publications:

- Modified steepest descent method for nonlinear irregular operator equations // Dokl. Math. 2015. V. 91, № 3. P. 300–303.
  DOI: 10.7868/S0869565215150086
- Vladimir Vasin and Santhosh George. An analysis of Lavrentiev regularization method and Newton type process for nonlinear ill-posed problems // Applied Mathematics and Computation. 2014. V. 210. P. 406–413. 123.
  DOI: 10.1016/j.amc.2013.12.104
- *Vasin V. V.* Approximation of solutions with singularities of various types for linear ill-posed problems // Doklady Mathematics. 2014. V. 89, Is. 1. P. 30–33.
  DOI: 10.1134/S1064562414010116

Entry requirements:

- Basic knowledge of functional analysis and computational mathematics.

NUMERICAL METHODS FOR THE SOLUTION OF THE FUNCTIONAL DIFFERENTIAL EQUATIONS

Department of Computational Mathematics

Many mathematical models in various scientific fields can be described by differential equations (ordinary or partial) and have the effect of heredity. As far as these objects are difficult for analytical research, the relevant problem is the development of effective numerical methods, the verification of their stability and convergence, the development and testing of the corresponding software.

Dr. Vladimir Pimenov
Head of Department,
Professor

v.g.pimenov@urfu.ru

Research interests:

- Numerical methods for the solution of the functional differential equations, the partial differential equations with delay and the fractional functional differential equations.
- Theory of the positional control of systems with delay.

Main publications:

- *Pimenov V., Lekomtsev A.* Convergence of the scheme with weights for the numerical solution of a heat conduction equation with delay for the case of variable coefficient of heat conductivity // Applied Mathematics and Computation. V. 256. 2015. P. 83–93.
  DOI: 10.1016/j.amc.2014.12.149
- *Pimenov V. G., Hendy A. S.* Numerical studies for fractional functional differential equations with delay based on BDF-type shifted Chebyshev approximations // Abstract and Applied Analysis. 2015. Article ID 510875. P. 1–12.
  DOI: 10.1155/2015/510875
- *Pimenov V. G., Tashirova E. E.* Numerical methods for solving a hereditary equation of hyperbolic type // Proceedings of the Steklov Institute of Mathematics. V. 281. S. 1. 2013. P. 126–136.
  DOI: 10.1134/S008154381305012X

Entry requirements:

- Basic knowledge of numerical methods.

MATHEMATICAL MODELING IN PHYSIOLOGY AND MEDICINE

Department of Computational Mathematics

Mathematical modeling in medical research.

Dr. Olga Solovyova
Professor

soloveva.olga@urfu.ru

Research interests:

- Mathematical modeling in physiology and medicine. Personalized models in cardiology.
- Numerical methods for solving ordinary differential equations and partial differential equations in life sciences.
- Software developing for complex systems, finite element methods, parallel computing.
- Image analysis in medical researches.

Main publications:

- *Solovyova O., Katsnelson L. B., Konovalov P. V., Kursanov A. G., Vikulova N. A., Kohl P., Markhasin V. S.* The cardiac muscle duplex as a method to study myocardial heterogeneity. Progress in Biophysics and Molecular Biology 08/2014; 115(2–3). DOI: 10.1016/j.pbiomolbio.2014.07.010
- *Pravdin S. F., Dierckx H., Katsnelson L. B., Solovyova O., Markhasin V. S., Panfilov A. V.* Electrical Wave Propagation in an Anisotropic Model of the Left Ventricle Based on Analytical Description of Cardiac Architecture PLoS ONE 05/2014; 9(5):e93617. DOI: 10.1371/journal.pone.0093617
- *Pravdin S. F., Berdyshev V. I., Panfilov A. V., Katsnelson L. B., Solovyova O., MarkhasinV. S.* Mathematical model of the anatomy and fibre orientation field of the left ventricle of the heart BioMedical Engineering OnLine 06/2013; 12(1):54. DOI: 10.1186/1475-925X-12-54
- *Markhasin V. S., Balakin A. A., Katsnelson L. B., Konovalov P., Lookin O. N., Protsenko Yu., Solovyova O.* Slow force response and auto-regulation of contractility in heterogeneous myocardium Progress in Biophysics and Molecular Biology 08/2012; 110(2-3). DOI: 10.1016/j.pbiomolbio.2012.08.011

Entry Requirements:

- Basic knowledge of dynamic systems, basic skills in numerical calculations, and programming (within the scope of the successfully completed undergraduate program).

COMBINATORIAL OPTIMIZATION AND MACHINE LEARNING

Department of Mathematical Economics

The main object of the program is studying the problems being on the border between two closely related fields of modern theoretical computer science: `Combinatorial Optimization' and `Machine Learning'.

The main topics are computational complexity and polynomial time approximation of combinatorial problems, design and implementation of learning algorithms of high generalization ability.

Dr. Michael Khachay
Professor

mkhachay@imm.uran.ru

Research interests:

- Combinatorial optimization: complexity, polynomial time approximation algorithms with performance guarantees, approximation schemes, thresholds, etc.
- Machine learning: statistical learning theory, ensembles of classifiers, performance guarantees.

Last year publications:

- *Khachay M.* Committee polyhedral separability: complexity and polynomial approximation // Machine Learning. 2015. DOI: 10.1007/s10994-015-5505-0
- *Khachai M., Neznakhina K.* Approximabiility of the problem about a minimum weight cycle cover of graph // Doklady Mathematics. 2015. V. 91, № 2. P. 240–245. DOI: 10.1134/S1064562415020313
- *Khachai M., Neznakhina K.* A polynomial-time approximation scheme for the Euclidean problem on a cycle cover of a graph // Proc. of Steklov Inst. of Math. 2015. V. 289, № 1. P. 11–125. DOI: 10.1134/S0081543815050107

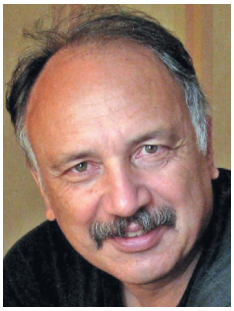
Entry requirements:

- Master degree in applied mathematics or computer science.
- The experience of independent research in the sphere of computational complexity of algorithms and/or theory of algorithmic (machine) learning.

THEORETICAL STUDIES AND MATHEMATICAL MODELING OF SOFT MAGNETIC MATERIALS

Department of Mathematical Physics

The program is focused on studying the properties and the mechanical behavior of the new type of materials for advanced industrial and medical and biological technologies - compositions of nano- and micro-sized magnetic particles in the polymeric environment. The goal of the theoretical studies of this issue is the development of mathematical models that allow predicting the properties and the behavior of these systems basing on the information about the characteristics, the form and the concentration of particles in the composite environment, as well as about the characteristics of the matrix containing them. The program is aimed at training specialists being aware of theoretical and computer methods of the description of the complex composite environments and materials.



Dr. Andrey Zubarev
Professor

A.J.Zubarev@urfu.ru

Research interests:

- Theoretical study of phase transitions and non equilibrium phenomena in complex fluids and soft matters – polymers, colloids, magnetic colloids and compositions of these material.

Main publications:

- *Modesto T. Lopez-Lopez, Ana Gomez-Ramirez, Laura Rodriguez-Arco, Juan D. G. Duran, Larisa Iskakova, Andrey Zubarev* Colloids on the Frontier of Ferrofluids // Rheological properties. Langmuir. 2012. 28. P. 6232–6245. DOI: 10.1021/la204112w
- *Iskakova L. Yu., Zubarev A. Yu.* Shear thickening of dense suspensions due to energy dissipation in lubrication layers between particles // Physical Review E. 2013. 88, 032303. DOI: 10.1103/PhysRevE.88.032303
- *Rodrıguez-Arco L., Lopez-Lopez M. T., Zubarev A. Y., Gdula K., Duran J. D. G.* Inverse magnetorheological fluids // Soft Matter. 2014. 10, 6256–6265. DOI: 10.1039/c4sm01103a

Entry Requirements:

- Basic knowledge of thermodynamics and statistical physics.
- Skills in numerical methods of solutions of differential and non-linear equations.

COMBINATORICS AND ALGORITHMICS OF WORDS AND RELATED OBJECTS

Department of Algebra and Discrete Mathematics

The program focuses on the structural, numerical, and algorithmic properties of sequences of symbols and related properties of trees and graphs.

Dr. Arseny Shur
Professor

arseny.shur@urfu.ru

Research interests:

- Combinatorics of words; automata and formal languages; stringology; graph theory.

Main publications:

- *Shur A. M.* Growth properties of power-free languages. Computer Science Review 6 (2012), 187–208.
  DOI: 10.1016/j.cosrev.2012.09.001
- *Idiatulina L. A., Shur A. M.* Periodic Partial Words and Random Bipartite Graphs. Fundamenta Informaticae 132 (2014), 15–31.
  DOI: 10.3233/FI-2014-1030
- *Kosolobov D., Rubinchik M., Shur A. M.* Pal^k is Linear Recognizable Online. SOFSEM 2015: Theory and Practice of Computer Science, 289–301.
  DOI: 10.1007/978-3-662-46078-8_24

Entry requirements:

- A sufficient background in discrete mathematics and theoretical computer science: algorithms and complexity, automata and formal languages, graphs, combinatorics, discrete probability.
- Programming skills are highly desirable.

LATTICES OF SEMIGROUP VARIETIES

Department of Algebra and Discrete Mathematics

The program allows joining the world-leading team in the area of semigroup varieties, learning the main achievements at first hand, and attacking a number of challenging open problems.

The main research directions are:

- Monoid varieties with modular subvariety lattices.
- Special elements in the lattice of monoid varieties.
- The lattice of semiring varieties

Dr. Boris Vernikov
Senior Researcher,
Vice-Head of Department

bvernikov@gmail.com

Research interests:

- Lattices of semigroup varieties.

Main publications:

- *Shevrin L. N., Vernikov B. M., Volkov M. V.* Lattices of semigroup varieties // Izv. VUZ. Matematika (2009) no. 3, 3-36 [Russian; English translation: Russian Mathematics (Iz. VUZ) (2009) 53, № 3, 1-28].
  DOI: 10.3103/S1066369X09030013
- *Vernikov B. M.* Special elements in lattices of semigroup varieties // Acta Sci. Math. (Szeged). 2015. V. 81, № 1–2. P. 79–109.
  HTTP://arxiv.org/pdf/1309.0228.pdf
- *Vernikov B. M.* Proofs of definability of some varieties and sets of varieties of semigroups // Semigroup Forum. 2012. V. 84, № 2. P. 374–392.
  DOI: 10.1007/s00233-012-9377-3
- *Monzo R. A. R., Vernikov B. M.* Identities determining varieties of semigroups with completely regular power // Semigroup Forum. 2011. V. 42, № 2. P. 384–388.
  DOI: 10.1007/s00233-011-9291-0

Entry requirements:

- Basic knowledge of the semigroup theory and the universal algebra.

THE FINITE BASIS PROBLEM FOR SEMIGROUPS

Department of Algebra and Discrete Mathematics

The program focuses on one of the major open problems on the edge between the semigroup theory and the universal algebra: Tarski's problem for finite semigroups. This fundamental problem reveals surprising connections to the modern computer science, in particular, to the complexity theory. PhD students willing to enroll in this program will work within a very international network of algebraists and computer scientists. The main research directions are:

- Computational complexity of deciding the finite basis property for finite semigroups.
- The finite basis problem for "graph-generated" semigroups, e.g., Hecke-Kiselman monoids.
- Relatively inherently non-finitely based J-trivial and R-trivial semigroups.

Dr. Mikhail Volkov
Professor, Principal Researcher,
Head of Department

m.v.volkov@urfu.ru

Research interests:

- Finite basis problem, Lattices of semigroup and ring varieties, Computational complexity.

Main publications:

- *Volkov M. V.* The finite basis problem for finite semigroups // Math. Japonica. 2001. 53. № 1. 171–199.
  HTTP://csseminar.imkn.urfu.ru/MATHJAP_revisited.pdf
- *Shevrin L. N., Volkov M. V.* Identities of semigroups // Izv. VUZ. Matematika. 1985. № 11. 3–47 [Russian; Engl. translation Soviet Math Izv. VUZ (1985) 29, № 11, 1-64].
- *Auinger K., Dolinka I., Volkov M. V.* Matrix identities involving multiplication and transposition // J. Europ. Math. Soc. 2012. 14, № 3. 937–969.
  DOI: 10.4171/JEMS/323
- *Auinger K., Dolinka I., Volkov M. V.* Equational theories of semigroups with involution // J. Algebra. 2012. 369. 203–225.
  DOI: 10.1016/j.jalgebra.2012.06.021

Entry requirements:

- Basic knowledge of semigroup theory, universal algebra, and computational complexity.

SYNCHRONIZING AUTOMATA AND THE ČERNÝ'S CONJECTURE

Department of Algebra and Discrete Mathematics

The program is related to a longstanding conjecture in the theory of finite automata: the Černý's conjecture. It deals with so-called synchronizing automata that are of both theoretical interest and practical value. The automata research team at Ural Federal University is very active and maintains many international contacts. The main research directions are:

- Connections between synchronizing automata and the theory of nonnegative matrices.
- New upper and lower bounds for the reset threshold within some important classes of synchronizing automata.
- Road coloring games.

Dr. Mikhail Volkov
Professor, Principal Researcher,
Head of Department

m.v.volkov@urfu.ru

Research interests:

- Synchronizing automata, Formal Languages, Computational complexity.

Main publications:

- *Volkov M. V.* Synchronizing Automata and the Černý Conjecture // C. Martin-Vide, F. Otto, H. Fernau (eds.), Language and Automata Theory and Applications. LATA 2008 [Lect. Notes Comp. Sci., 5196], Springer-Verlag, Berlin-Heidelberg-N.Y., 2008. 11–27.
  DOI: 10.1007/978-3-540-88282-4_4
- *Ananichev D. S., Gusev V. V., Volkov M. V.* Primitive digraphs with large exponents and slowly synchronizing automata // J. Math. Sci. 2013. 192, no. 3. 263–278.
  DOI: 10.1007/s10958-013-1392-8
- *Fominykh F. M., Martyugin P. V., Volkov M. V.* P(l)aying for synchronization // Int. J. Foundations Comp. Sci. 2013. 24, № 6. 765–780.
  DOI: 10.1142/S0129054113400170.
- *Volkov M. V.* Synchronizing automata preserving a chain of partial orders // Theor. Comput. Sci. 2009. 410. № 37. 3513–3519.
  DOI: 10.1016/j.tcs.2009.03.021

Entry Requirements:

- Knowledge of some basics of automata theory, formal languages, and computational complexity. Programming skills will be an advantage.

STATISTICAL MECHANICS OF MAGNETIC FLUIDS

Department of Mathematical Physics

The program is focused on the theoretical description of the properties of magnetic fluids with the help of both the mathematical methods of statistical mechanics and the computer simulations.

Dr. Alexey Ivanov
Professor

Alexey.Ivanov@urfu.ru

Research interests:

- Stastistical mechanics of magnetic fluids and dipolar fluids.
- Magnetic properties and structural transformations.

Main publications:

- *Elfimova E. A., Ivanov A. O., Camp P. J.* Theory and simulation of anisotropic pair correlations in errofluids in magnetic fields // Journal of Chemical Physics. 2012. V. 136. Is. 19. Art. 194502-01-12.
  DOI: 10.1063/1.4717718
- *Kantorovich S., Ivanov A. O., Rovigatti L., Tavares J. M., Sciortino F.* Nonmonotonic magnetic susceptibility of dipolar hard-spheres at low temperature and density // Physical Review Letters. 2013. V. 110, № 14. Art. 148306.
  DOI: 10.1103/PhysRevLett.110.148306
- *Elfimova E. A., Ivanov A. O., Camp P. J.* Thermodynamics of ferrofluids in applied magnetic fields // Physical Review E. 2013. V. 88, № 4. Art. 042310.
  DOI: 10.1103/PhysRevE.88.042310

Entry Requirements:

- Basic knowledge of thermodynamics and statistical physics.
- Skills in numerical methods of computer simulations.

INSTITUTE OF FUNDAMENTAL EDUCATION

Institute of Fundamental Education is the institute established for solving the main task of Ural Federal University: achievement of the world-level quality in the area of fundamental training in Mathematics, Foreign Languages, IT, Engineering; these are the fields of knowledge that form the basis for developing thinking and professional skills.

Today the Institute of Fundamental Education provides high-quality training in 6 directions of training:

- Linguistics.
- Information Systems & Technology.
- Fundamental Informatics and Information Technologies.
- Applied Informatics.
- Technosphere Safety.
- Fire Safety.

Ilya Obabkov,
Director of the IFE

Ural Federal University

named after the first President of Russia B.N.Yeltsin

Institute of Fundamental Education

The educational programs of the Department of Information Systems & Technology and the Department of Intellectual Information Technologies are aimed at training of IT specialists in the area of software engineering. These specialists are highly qualified professionals in the implementation of systematic, regulated and quantified approaches for problem solving of designing, development, exploitation, software maintenance.

Department of Foreign Languages and Translation is the university leader in the sphere of language training. The Department trains specialists with the necessary competences for professional intercultural communication and subsequent scientific activities, also qualified for working with international companies and universities.

Departments of Physics, General Chemistry, Engineering Graphics, Structural and Analytical Mechanics have strong and modern laboratory facilities. In these departments, the students study engineering and technical disciplines. Providing high-quality training in these fields is one of the main directions of the Institute's activity. Besides, among the main tasks of the Department of Physics there are training of specialists in the area of condensed matter physics and conducting of joint scientific survey on priority scientific direction "Nanomaterials industry". In the Department, there is the Regional Scientific-Methodical Centre "Modern Physics Workshop" which develops and implements new laboratory and demonstrative equipment, and modern information technology in education process.

DOCTORAL STUDIES AT THE IFE

UrFU Institute of Fundamental Education offers a range of Doctoral Programs in the fields of Physics and Engineering. In this brochure you will find a brief description of these Programs, alongside with the information about the thesis advisors.

We offer:

- 4 year Doctoral Programs.
- Accommodation in a University dormitory.
- The possibility to be employed as a researcher in the group of your thesis advisor.
- Free Russian language courses.
- The possibility to defend the Candidate of Science* theses or an UrFU PhD thesis.

*The first doctoral degree in Russia (Kandidat Nauk). It is gained after 3 to 5 years in a post-graduate school. The qualification requirements include mandatory publications in peer reviewed journals and approval on the Federal government level.

Entry requirements:

- Master's Degree in a field related to the field of Doctoral Studies.
- B2 level of English or Russian.
- Interview.

For further information, please contact:

Nikolai Khlebnikov
NA.Khlebnikov@urfu.ru

THEORY OF STRONGLY CORRELATED D-, F-METALS AND COMPOUNDS

Department of Physics

The fields studied in this program are the Hubbard model; fluctuation theory; magnetic phase diagrams; superconductivity and magnetism; modeling of electronic structure; modeling of electronic and lattice properties.

Dr. Alexander Povzner
Head of the Department of Physics, Professor

a.a.povzner@urfu.ru

Research interests:

- Condensed matter theory, strongly correlated electron systems, magnetism and superconductivity; chirality magnetism; lattice and spin anharmonism.

Main publications:

- *Tsiovkin Yu. Yu., Povzner A. A. et. al.* Calculation on the temperature dependence of electrical resistivity in the transuranium metals and their alloys // Phys. Rev. 2007. B 78, 075119.
  DOI: 10.1103/PhysRevB.76.075119
- *Povzner A. A. et. al.* Electronic structure and magnetic susceptibility of monoclinic *α*-plutonium // JETP Letters. 2014. 99(11), 760–765.
  DOI: 10.1134/S0021364014110095
- *Lukoynov A. V., Shorikov A. O., Povzner A. A. et. al.* Electronic structure and magnetic state of transuranium metals // J. Phys. 2010. C 84, 495501.
  DOI: 10.1088/0953-8984/22/49/495501
- *Povzner A. A. et al.* Phonon anharmonicity of iron monosilicide // Physica. 2015. B 456. 371–374.
  DOI: 10.1016/j.physb.2014.09.028
- *Povzner A. A. et al.* Non-equilibrium phase transition into ferromagnetic semiconductor nanofilms in an electric field // JMMM. 2015. 373, 169–172.
  DOI: 10.1016/j.jmmm.2014.01.064
- *Povzner A. A. et al.* Spin-fluctuation mechanism of superconductivity of strongly correlated transition metal compounds with pd-hybridization // J. Superconductivity and Novel Magnetism. 2015. 28 (2). 297–301.
  DOI: 10.1007/s10948-014-2791-x

MODELING THE DYNAMICAL PROCESS AT NON-EQUILIBRIUM PHASE TRANSITION IN MAGNETIC SEMICONDUCTORS

Department of Physics

The fields studied in this program are planar metallic and semiconductor nanosystems; magnetic and electronic phase transitions in electrical and magnetic fields; order-disorder transition; generator self-excited oscillations of spin-polarized currents and voltages.

Dr. Alexander Povzner
Head of the Department of Physics, Professor

a.a.povzner@urfu.ru

Research interests:

- Condensed matter physics, phase transitions, magnetic semiconductor, colossal magnetoresistance effect, autooscillations currance and voltage, magnetic nanofilms.

Main publications:

- *Povzner A. A. et al.* Non-equilibrium phase transition into ferromagnetic semiconductor nanofilms in an electric field // JMMM. 2015. 373, 169–172. DOI: 10.1016/j.jmmm.2014.01.064
- *Volkov A. G., Povzner A. A. at al.* Features of kinetic electron transitions in magnetic semiconductors//Technical Physics. 2009. V. 54, (6). 919–922. DOI: 10.1134/S1063784209060243
- *Volkov G., Povzner A. A.* Anomalous influence of an external magnetic field on spin fluctuations in magnetic semiconductors with strong p -d hybridization and the colossal magnetoresistance effect // Physics of the Solid State. 2012. V. 54, (12), 2351–2356. DOI: 10.1134/S1063783412120347
- *Povzner A. at al.* Electronic Structure and Spin-Fluctuation Effects in the Normal Phase PuCoGa5//Journal of Superconductivity and Novel Magnetism. 2013. V. 26 (5), 1653–1656. DOI: 10.1007/s10948-012-2076-1
- *Melkikh V., Povzner A. A.* Autooscillations under self-heating conditions in a semiconductor//Technical Physics Letters. 2003. V. 29 (3). 224–225. DOI: 10.1134/1.1565640

THE ANISOTROPY OF PROPERTIES OF TEXTURED MATERIALS

Department of Theoretical Mechanics

The fields studied in this program are Mathematical models of material structures, new architectural solutions in the simulation of real engineering structures kinematic methods; modeling of the properties (conductivity, elasticity, plasticity) of anisotropic materials (metals, alloys, composites).

Dr. Svetlana Berestova
Professor

s.a.berestova@urfu.ru

Research interests:

- The problem of averaging of physical and mechanical properties of micro-inhomogeneous environment.

Main publications:

- *Berestova S. A., Mityushov Ye. A.* An exact determination of the effective moduli of elasticity of micro-inhomogeneous media // Journal of Applied Mathematics and Mechanics. 1999. V. 63, l. 3. P. 505–507. HTTP://www.scopus.com/inward/record.url?eid=2-s2.0-0033233813&partnerID=40&md5=a72273a8cda93b1669ca59d2029f204a
- *Berestova S. A.* Simulation of the elastic-plastic deformation of bcc and fcc polycrystals // Fizicheskaya Mezomekhanika. 2005. V. 8, l. 2. P. 11–18.

THE MECHANICS OF ANISOTROPIC INHOMOGENEOUS MATERIALS

Department of Theoretical Mechanics

The fields studied in this program are Mathematical models of material structures, new architectural solutions in the simulation of real engineering structures kinematic methods; modeling of the properties (conductivity, elasticity, plasticity) of anisotropic materials (metals, alloys, composites).

Dr. Evgenii Mityushov
Professor

mityushov-e@mail.ru

Research interests:

- Separation of geometrical and physical parameters in the description of the properties (conductivity, elasticity, plasticity) of anisotropic materials (metals, alloys, composites).
- Computer geometry. Shaping.
- Mathematical models of material structures, new architectural solutions in the simulation of real engineering structures kinematic methods.

Main publications:

- *Berestova S. A., Mityushov Ye. A.* An exact determination of the effective moduli of elasticity of micro-inhomogeneous media // Journal of Applied Mathematics and Mechanics. 1999. V. 63, l. 3. P. 505–507.
  HTTP://www.scopus.com/inward/record.url?eid=2-s2.0-0033233813&partnerID=40&md5=a72273a8cda93b1669ca59d2029f204a
- *Mityushov E. A.* Reinforcement Theory // Mechanics of composite materials and structures. 2000. V. 6, l. 2. P. 151–161.
- *Berestova S. A., Mityushov E. A.* Physical equations of plastic flow theory anisotropic metal // Proceedings of the Russian Academy of Sciences. Mechanics of Solids. 2004. V. l. 5. P. 96.
- *Zhilin S. S., Misyura N. E., Mityushov E. A.* Application of mathematical modeling in the architectural design of tall buildings // Academic Gazette UralNIIproekt RAASN. 2014. V. l. 2. P. 39–43. The mechanics of anisotropic inhomogeneous materials.
  DOI: 10.1007/s10948-014-2791-x

CONTACTS

Ural Federal University named after the First President of Russia B.N.Yeltsin
19, Mira str.
620002, Ekaterinburg

Vladimir Kruzhaev
Vice-Rector for Research
19, Mira str., room GUK-21
620002, Ekaterinburg, Russia
phone: +7 (343) 375-48-90
v.v.kruzhaev@urfu.ru

Department of Information and Analytical Systems and International Projects
4, Turgenev str., room 262
620000, Ekaterinburg, Russia
phone: +7 (343) 350-30-77
science.projects@urfu.ru

@Ural_Federal
UrFUnews
ural_federal
http://www.linkedin.com/company/ural-federal-university
http://www.youtube.com/user/stvTVIST

urfu.ru

Ekaterinburg, 2015
UrFU Publishing and Printing Center

The persons that appear in the photographs of the present brochure are students, staff members or partners of Ural Federal University. UrFU thanks everyone who participated in the creation of this brochure.